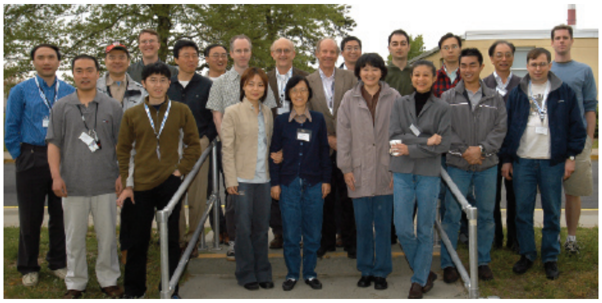
Workshop on High Pressure Mineral Physics Using Synchrotron Radiation

May 21, 2003

Most techniques for probing materials using synchrotron radiation can be applied to materials at high pressures and temperatures using either the Diamond Anvil Cell (DAC) or the Large Volume Press (LVP, also known as the Multianvil Press). These techniques include diffraction (both energy-dispersive using white radiation and angle-dispersive using white radiation); radiographic imaging; ultrasonic interferometry; stress and strain measurements; infrared spectroscopy; Raman spectroscopy; and inelastic scattering. Presentations will be made discussing most of these techniques and scientific applications of these technique.

—Michael Vaughan



Attendees at the workshop on High Pressure Mineral Physics Using Synchrotron Radiation.

Workshop on EXAFS Under Extreme Experimental Conditions: EXAFS in the Realms of Small Spot Size, Low Energy, Low Sample Concentration, or Fast Time Resolution

May 21, 2003

EXAFS is well established as a measurement technique used in a broad range of scientific disciplines. Within certain experimental constraints, high quality data is routinely obtained by users of synchrotrons around the world. In recent years, the scope of EXAFS has been expanded by advances in measurement techniques. At this year's NSLS Users' Meeting, these exciting developments were explored in a workshop titled, "EXAFS Under Extreme Experimental Conditions: EXAFS in the realms of small spot size, low energy, low sample concentration, and fast time resolution," organized by Bruce Ravel of the Naval Research Laboratory in Washington, DC. Just as EXAFS is commonly used by researchers from many different scientific disciplines, so too did our speakers present results from many different disciplines, including chemistry, environmental science, and materials physics.

Barukh Yaakobi of the University of Rochester began the workshop by discussing the use of laser-generated shocks with imploding targets as the radiation source for his EXAFS experiments. Dr. Yaakobi discussed measurements of an ultra-fast structural phase transition in titanium metal induced by the laser-generated shock and measured in dispersive mode. He was followed by Vadim Palshin from Louisiana State University and CAMD, who discussed the experimental challenges of low-energy EXAFS measurements. He presented detailed structural refinements on the silicon K-edge silicon-containing, thin, amorphous carbon films.

Lin Chen of Argonne National Laboratory spoke of using the time structure of a stored current to measure photo-excited molecular structures. In these experiments, very short-lived molecular states are measured in a pump-probe geometry wherein the molecular population is laser-excited and the excited state is measured by an x-ray pulse incident during its lifetime. Shelly Kelly also of Argonne National Laboratory spoke of uranium L_3-edge EXAFS at environmentally relevant concentrations. Environmentally relevant concentrations strain the limits of detectability even with third generation light sources and Dr. Kelly discussed the experimental concerns of low sample concentrations and addressed the limits of sample dilution

Attendees at the workshop on EXAFS Under Extreme Experimental Conditions: EXAFS in the Realms of Small Spot Size, Low Energy, Low Sample Concentration, or Fast Time Resolution.

for full analysis of the EXAFS signal. The final talk was by Ronald Cavell of the University of Alberta. He spoke on the use of microprobe EXAFS sources to map the composition of heterogeneous materials. He presented results of mapping and structural determination of the components of a meteor sample.

There is a rule of thumb that the measurements of elemental identification, XANES measurement, and EXAFS measurements require increasing orders of magnitude of photon flux or sample concentration. Consequently detailed EXAFS analysis in the limits of small spot size, low energy, low concentration, or fast time resolution requires special considerations for sample preparation and measurement. In many cases these experimental limitations have only been addressed since the advent of technical advances such as third generation sources. This workshop provided an excellent snapshot of the current state of the art technology for each of these extreme realms of EXAFS measurement and analysis.

—Bruce Ravel

UEC Community Service Award Presented to Michael Sullivan

May 20, 2003

Congratulations go out to Michael Sullivan, Chief Beamline Engineer for Albert Einstein College of Medicine. Mike is the second annual recipient of the NSLS Users' Executive Committee (UEC) Community Service Award. This award is given for service, innovation, and dedication to users of the NSLS.

Members of the NSLS user community nominated Mike for this award. Here are some of the comments that users sent about his wonderful contributions:

- "Mike is admired as a tireless, creative force dedicated to the principle of delivering user service."
- "In my opinion Mike is one of the most knowledgeable and extremely helpful engineers at NSLS floor, with very long experience [19 years] with dealing with all technical aspects of many different kinds of x-ray synchrotron research conducted at NSLS. He is a person who made it possible for very many staff and visitors to obtain top quality research results."
- "On several occasions, he has come in on weekends to help us salvage an experiment gone awry, or to bail us out of a technical problem. On one occasion, we reached him via his cell phone on his boat at sea, and he was able to come in and fix the problem to keep us running."
- "Mike is undoubtedly a gold standard of service, innovation, and dedication to users. Moreover, during this winter's biggest blizzard, I remember walking by the NSLS parking lot when Mike turned his car into a towing truck in order to help his users to pull out their car out of a huge pile of snow."

Leemor Joshua-Tor, the Chair of the NSLS UEC, presented the award to Mike at the NSLS Users' Meeting banquet on the evening of May 20th. Mike received a $250 gift certificate and his name was engraved on the plaque on display in the lobby of the NSLS.

—Leemor Joshua-Tor

Michael Sullivan, NSLS Users' Executive Committee (UEC) Community Service Award winner.

NSLS Scientist Ron Pindak Awarded Tenure

June 1, 2003

Brookhaven Science Associates (BSA) granted tenure on June 1 to nine Brookhaven scientists. They are: Mark Baker, Chemistry Department; Leslie Bland, Physics Department; Christopher Homes, Physics; Jean Logan, Chemistry; Ron Pindak, National Synchrotron Light Source Department; David Schlyer, Chemistry; Subramanyam Swaminathan, Biology Department; Dejan Trbojevic, Collider-Accelerator Department; and Gene-Jack Wang, Medical Department.

As described in the Scientific Staff Manual, "a tenure appointment constitutes recognition of independent accomplishment of a high order in the performance of original research or of other intellectually creative activity appropriate to Laboratory purposes."

Recognition may be earned through significant contributions to knowledge related to the purposes of the Laboratory and/or in furtherance of the Laboratory's aims, through continuing contributions of outstanding significance to productive uses of the facilities, or outstanding and creative contributions to their design, development, and improvement.

For his outstanding contributions and sustained high-quality original research in the study of complex fluids, with particular emphasis on liquid crystals, Ron Pindak, NSLS Department, was awarded tenure.

"Ron consistently picks fundamentally important problems to work on and has an ability to design experiments to get at the heart of an issue," said Steven Dierker, NSLS Chair and Associate Laboratory Director for Light Sources. "He has amply demonstrated the versatility and expertise to practice whatever technique is necessary, sometimes by collaborating with others to learn the technique before applying it on his own, and in other cases by playing a lead role in developing a new technique."

Pindak's early work in forming free-standing liquid crystal films led to his experimental verification of the hexatic phase, a new state of matter with order intermediate between that of a liquid and of a solid. Later, he and collaborators discovered and characterized the "Twist Grain Boundary Phase," the liquid crystal analogue of the Abrikosov flux lattice in superconductors with screw dislocations playing the role of flux vortices.

Pindak joined BNL in 2001 as a physicist after a distinguished 24-year career at Bell Laboratories. During his career at Bell Labs, he had led a collaboration at the NSLS that pioneered the use of resonant x-ray scattering to elucidate molecular order in chiral ferri- and antiferro-electric liquid crystals. This required working in a low-energy x-ray region where air is very absorbing, so special instrumentation, a goniometer and x-ray polarization analyzer, which would operate in a helium atmosphere, had to be designed and constructed.

Said Dierker, "The unique insight provided by the measurements established by Ron's work has provided the motivation for developing this capability as a standard technique for the user program on one of the NSLS low-energy x-ray beamlines."

Most recently, Pindak has been a key contributor to the development of the Coherent Bragg Rod Analysis technique, which measures the phase of x-rays scattered by two-dimensional structures, such as epitaxial films or interfaces, to allow an absolute determination of the atomic positions. He is now exploring whether this technique can be extended to study two-dimensional protein crystals.

In addition, since joining the NSLS, Pindak has headed the Science Program Support Section of the User Science Division, and taken the lead in developing a soft condensed matter program. He also served as the Interim Associate Director for the BNL Nanocenter. Currently, together with Lin Yang, he is developing a small angle x-ray scattering beamline and starting soft matter and biophysics research relevant to understanding nanoscale device fabrication and operation.

Pindak received his Ph.D. in physics from the University of Pennsylvania in 1975.

— Liz Seubert

Ron Pindak

Dierker Named Associate Laboratory Director For BNL's New Light Sources Directorate

June 5, 2003

Steven Dierker, a forefront scientist and administrator in synchrotron light research, was named Associate Laboratory Director for the new Light Sources Directorate at BNL. Dierker, who is Chair of the NSLS, will also retain that position.

Steven Dierker

The NSLS at BNL is one of the world's most widely used scientific facilities. Each year, about 2,500 researchers from more than 400 universities, companies, and government labs use its bright beams of x-rays, ultraviolet light, and infrared light for research in such diverse fields as biology and physics, chemistry and geophysics, medicine and materials science. For example, scientists have used the NSLS to produce imagesof the AIDS virus as it attacks a human cell, develop a method for breast cancer detection that is more accurate than mammography, and create a method to make faster, denser computer chips. The facility has 175 employees and a current annual budget of about $38 million.

"I am pleased about the continued growth of the NSLS Department," Dierker said. "Since its commissioning in 1982, the NSLS has continually updated and expanded its capabilities to remain at the forefront of science. Now we are proposing a major upgrade - essentially a new light source at Brookhaven."

BNL created the new Light Sources Directorate and promoted Dierker to his present position because of the importance of upgrading NSLS facilities within the next decade.

The project represents the next major step in the Lab's long history of building and operating world-class scientific facilities and is expected to have enormous impact in the life sciences, materials and chemical sciences, nanoscience, geoscience, environmental science, and other areas. Advanced light source capabilities would also complement the Center for Functional Nanomaterials at Brookhaven, which is due to be built starting in 2005 and to become fully operational by 2008.

After earning B.S. degrees in both physics and electrical engineering in 1977 from Washington University, Dierker earned both an M.S. and Ph.D. in physics from the University of Illinois, Urbana-Champaign, in 1978 and 1983, respectively. In 1983, he joined the Semiconductor and Chemical Physics Research Department at AT&T Bell Laboratories (now Lucent Technologies), and, in 1990, he joined the University of Michigan, where he was Professor of Physics and Applied Physics. He joined BNL in May 2001 to become Chair of the NSLS.

Since 1992, Dierker has been a member of the NSLS Users Group, and he performed initial experiments at the NSLS to develop a novel synchrotron technique called x-ray photon correlation spectroscopy, which uses coherent, or highly ordered, synchrotron beams to study colloidal systems, or particles dispersed in a solid, liquid, or gaseous medium, and polymers.

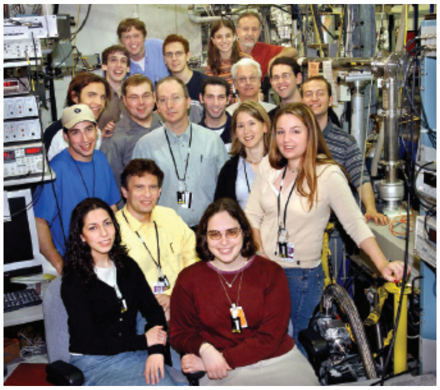
Since 1996, Dierker has been a member of the Advanced Photon Source (APS) Users Organization at Argonne National Laboratory, and he chaired that organization from 1998-2000. He also helped to plan the construction, design, and operation of beamlines at the APS, with funding from DOE and the National Science Foundation.

— Diane Greenberg

Yeshiva University Undergraduates Experience Hands-On Research at BNL

June 17, 2003

In June 2003, 12 students and 3 instructors from Yeshiva University (New York) spent a week at Brookhaven National Laboratory as part of an undergraduate course entitled "Experiments in Modern Physics". This course was developed by Yeshiva Physics Professor Anatoly Frenkel, in collaboration with his departmental colleagues Professors Gabriel Cwilich and Fredy Zypman. Professor Frenkel is also a long-time NSLS beamline scientist at X16C. The course was five weeks long, including four weeks on the Manhattan campus where students had lectures and labs introducing them to the foundations of modern physics, and one week of "mini-experiments" at BNL. Students participating in the course had widespread backgrounds, majoring in Physics, Political Science, English and Psychology.



Yeshiva University undergraduates and faculty enjoy their summer mini-experiments at the NSLS.

The most attractive component of the new course was the Brookhaven visit. The purpose of this visit (and the entire course) was to help students understand modern physics through a series of mini-experiments, while exposing them to the atmosphere of a National Lab where modern physics is practiced every day. The five BNL experiments were organized in collaboration with BNL scientists who helped to plan and run the experiments for several shifts of students. In this way teams of 3-4 students could rotate between all of the experiments during the week.

Three experiments, the "Photoelectric Effect," organized by Anatoly Frenkel, "Time-Resolved Chemistry," Jon Hanson (BNL-Chemistry), and "Fingerprinting of Fingerprints," organized by Lisa Miller (BNL-NSLS) were run at the NSLS beamlines X16C, X7B and U10B, respectively. The experiments were designed to show students both the laws of physics (photoelectric effect and x-ray absorption; x-ray diffraction and Bragg's law; absorption of infrared light by vibrating molecules) and elements of research. Two additional experiments, "Nuclear Decay" and "Electron-Positron Annihilation," were organized by Kathryn Kolsky and Leonard Mausner at BNL's Isotope Facility. There the students visited the Brookhaven LINAC Isotope Producer (BLIP) and spent two days studying properties of gamma radiation (absorption, element characterization, inverse square law and the law of radioactive decay) by operating the facility's germanium gamma ray detectors. They were particularly fascinated by utilizing the $E = mc^2$ law to obtain the electron mass from the characteristic "electron-position annihilation" peak at 511 MeV.

For most of the students it was the first experience of this kind. They endured working long shifts, participating in the ongoing laboratory research and enjoying the sense of "discovery" in learning. The entire group thanks the Brookhaven teams of scientists for their help and the NSLS for financial support. The course is now used as a prototype for a new course "Current Topics in Nanoscience" that is under development by the Yeshiva faculty.

— Anatoly Frenkel

'Mail-In' Crystallography at the NSLS Featured in *Nature*

June 19, 2003

BNL's Howard Robinson, Biology Department, who runs the "mail-in" crystallography program at the NSLS, got star billing (and photo prominence, right) in a news feature on the subject in the June 19, 2003, issue of *Nature*. Since 2000, Robinson and others at the NSLS have offered a mail-in data-collection service for scientists who want to solve protein structures without having to travel to a synchrotron themselves. According to the Nature article, such services are becoming increasingly popular for biologists without formal training in crystallography and for those who would rather not wait for time on a beamline. Robinson's team at the NSLS typically works on about 50 mail-in projects a year, free to academic scientists. Consistent with BNL's mission of making its highly specialized research facilities available to outside researchers, this mail-in program broadens BNL's service to science and is helping to speed up the process of biological research. The program is funded by the Office of Basic Energy Sciences and Office of Biological & Environmental Research within DOE's Office of Science and the National Institute of Health's National Center for Research Resources.

Howard Robinson

— Karen McNulty Walsh

NSLS EXAFS Data Collection and Analysis Short-Course Has Another Successful Year

July 14 - 17, 2003

A hands-on EXAFS Data Collection and Analysis Course was held July 14-17, 2003 at the NSLS. The course was co-organized by Bruce Ravel (Naval Research Laboratory) Simon Bare

(UOP LLC), with superb administrative support by Lisa Tranquada (SFA, Inc.). Twenty-eight eager participants (graduate students, postdocs, and institution and industrial scientists) representing universities, national laboratories, research institutes, and industry attended the course. Of these, there were ten new users to the NSLS. The participants had diverse research interests across a broad spectrum of scientific fields (materials science, geological and environmental sciences, catalysis, and biology) and attended to learn how XAFS may be applied to their research program.

The four-day course was divided into morning lectures, with two afternoons of hands-on data collection using seven different NSLS spectroscopy beamlines (X9B, X11A, X18B, X19A, X23A2, X23B, and X26A), and two afternoons of data analysis. The instructors on the beamlines were Faisal Alamgir, Wolfgang Caliebe, Scott Calvin, Syed Khalid, Tony Lanzirotti, Nebojsa Marinkovic, and Kaumudi Pandya.

The eight morning lectures were: "Introduction to XAFS," given by Matt Newville (University of Chicago), "Basics of sample preparation" by Scott Calvin, "XANES measurement and interpretation" by Simon Bare (UOP LLC), "Detectors and synchrotron radiation" by Peter Siddons (BNL), "Basics of data processing" by Shelly Kelly (Argonne National Laboratory), "Introduction to theory" by John Rehr (University of Washington), "Introduction to analysis" by Anatoly Frenkel (Yeshiva University), and "Applying XAFS into a research program" by Rich Reeder (Stony Brook University). The time allotted for the lectures allowed ample time for stimulating discussion, which often developed.

For the first two days of the course, after attending the morning lectures, the participants were divided into small groups by research discipline to conduct the experimental part of the course. Each student became familiar with beamline operation and collected real XAFS data on representative samples from their own individual research projects. On the last two days, following the morning lectures, the participants learned data analysis techniques using their own data they had just collected. The participants also enjoyed ample time for informal discussion over coffee and in the evenings over the excellent dinners that were included in the course fee.

There was a tremendous amount of information disseminated over the four days. All the participants left the course with new friends and armed with the basic tools to apply x-ray absorption spectroscopy to their own research programs.

Participants in the 2003 NSLS EXAFS course.

We plan to offer the course again in 2004 – check the NSLS website for updated information.

The course was sponsored by the NSLS, with support from the Center for Environmental Molecular Science at Stony Brook University.

— Simon Bare

NSLS Summer Sunday Draws a Record-Breaking Crowd

August 3, 2003

On Sunday August 3, 2003, over 750 visitors toured the NSLS as part of Brookhaven National Laboratory's Summer Sunday tour series. Thirty-five NSLS staff members, students, and users volunteered their time for the event, which was organized by NSLS scientist, Lisa Miller.

University of Chicago scientist Tony Lanzirotti animated scientific research at the NSLS to an overflowing NSLS seminar room crowd.

Each summer, BNL is open for tours on seven consecutive Sundays, feature exciting interactive exhibits and an inside look at a different Laboratory facility each week, including the NSLS.

Tours of the NSLS included presentations, demonstrations, and hands-on exhibits. At Berkner Hall, visitors watched an introductory video about how a synchrotron works, narrated by NSLS Chairman Steve Dierker. After a short bus ride and tour of the Lab, visitors were dropped off at the NSLS. In the seminar room, NSLS scientists presented an introduction to "Science at the NSLS" by describing the many ways the NSLS is used to study scientific problems that affect everyday life. Improvements in biomedical imaging techniques, drug design, catalytic converters, environmental cleanup, and computer storage media were just a few of the topics discussed.

Visitors then toured the NSLS lobby, which was transformed into an exhibit area for numerous light- and synchrotron-related demonstrations. Visitors were able to experience "total internal reflection" as a laser beam was guided through a stream of falling water. A display on the principles of vacuum demonstrated its effect on a ringing bell, a balloon, a feather, and a marshmallow. The technique of diffraction was demonstrated using tiny metal grids and compact disks. Visitors had the opportunity to build their own "crystals" using gumdrops, and "see" the synchrotron light (at least the visible part of the spectrum) transported to the lobby through a fiber optic. But perhaps one of the all-time favorite features in the NSLS lobby was the view of the experimental floor from the display windows, which continues to amaze visitors year after year.

In addition to the many exhibits at the NSLS, BNL volunteers at Berkner Hall engaged visitors in a number of other activities. A hands-on exhibit called "Brain Matters," produced by the Oregon Museum of Science and Industry and funded by the National Institutes of Health, offered visitors the opportunity to explore the wonder of the brain and test their skills in solving challenging "brain twisters." Also, an exhibit about the 2002 Nobel Prize in Physics awarded to a Brookhaven Lab scientist was on display, and the Camp Upton Historical Collection featured memorabilia from World Wars I and II. The ever-popular "Whiz Bang Science Show" — popular with both adults and children — was also shown several times during the day. Both children and adults enjoyed lively interactive demonstrations of basic scientific principles. How does a "Bernoulli blower" float a beach ball in the air? What's a corrugaphone and how does sound travel through it? These were just a few of the intriguing items covered in the show.

—Lisa Miller

NSLS scientist Vivian Stojanoff shows how much fun it can be to build crystal models out of gumdrops and toothpicks.

Fun with vacuum techniques was demonstrated by Alec Bernston (left), a Cornell University freshman that was a summer student at the NSLS.

In a series of articles published in the Bulletin, some research that was presented at the 226th meeting of the American Chemical Society (ACS), September 7-11, 2003, in New York City was featured.

Important Intermediate Isolated With Help From Reverse Reaction

September 7-11, 2003

BNL chemists have used a new way to isolate and study an important Intermediate in a chemical reaction: They run the reaction in reverse.

By starting with the final products — epoxides— and placing them on the surface of a model catalyst, the chemists are able to use surface chemistry techniques to "catch" the intermediate. Understanding this intermediate may ultimately help in developing improved or new catalysts for the forward reaction — a reaction that produces important "building blocks" in the manufacture of larger organic molecules.

In the forward direction, the interaction of the reactants with the surface is either too weak to allow direct study of the mechanism, or the intermediate — a ring structure on the surface of the silver catalyst — forms and transforms too quickly for scientists to study. But in reverse, the intermediate stays on the surface longer, so scientists

The NSLS lobby ws filled with visitors all day on the NSLS Summer Sunday.

can apply various techniques to try to understand the reaction mechanism.

"If we find a general rule based on our studies with this model catalyst, then we can design a new catalyst, because we know how the reaction occurred on the surface," said the BNL Chemistry Department's Hong Piao, who is working on the project. The general goal is to improve the reactivity and selectivity of the catalyst for producing particular products.

Piao presented a talk on this work at the American Chemical Society's September meeting's Division of Colloid and Surface Chemistry poster session, "Fundamental Research in Colloid and Surface Chemistry." This work was funded by the Division of Chemical Sciences, Office of Basic Energy Sciences at DOE's Office of Science.

— Karen McNulty Walsh

Nanoscale Model Catalyst Paves Way Toward Atomic-Level Understanding

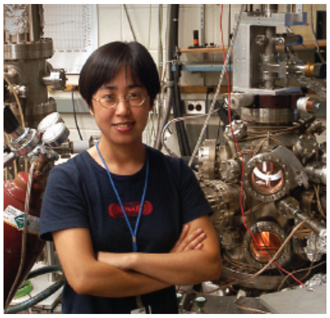
September 7-11, 2003

In an attempt to understand why ruthenium sulfide (RuS_2) is so good at removing sulfur impurities from fuels, BNL chemists have succeeded in making a model of this catalyst — nanoparticles supported on an inert surface — which can be studied under laboratory conditions.

"If we can understand why this catalyst is so active, we might be able to make it even better, or use what we learn to design other highly efficient catalysts," said Tanhong Cai of the BNL Chemistry Department, one of the scientists who made the model.

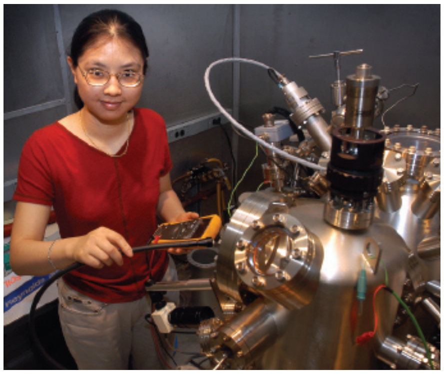
Removing sulfur from fossil fuels such as oil and coal is mandated because the resulting fuels burn more cleanly and efficiently. One common way of achieving this is to add hydrogen in the presence of a catalyst to release hydrogen sulfide (H_2S).

Recently, RuS_2 was found to be 100 times more active than the catalyst most commonly used for this "hydrodesulfurization" reaction. But studying the catalyst in action is nearly impossible because the reaction takes place at high temperatures and under extreme pressure.



Hong Piao

The BNL team has therefore created a model of the catalyst via a chemical reaction that deposits nanosized particles of RuS_2 on a nonreactive gold surface. The small size of the particles maximizes the surface area available for the catalytic reaction to take place, and makes it ideal for analysis by classic surface chemistry techniques, such as scanning tunneling microscopy and x-ray photoemission spectroscopy. The entire model is being studied under well-defined ultrahigh vacuum conditions.



Tanhong Cai

Cai presented a talk on the preparation and characterization of this model catalyst at the American Chemical Society's September meeting during the "Size-Selected Clusters on Surfaces, Division of Physical Chemistry" session. The work was funded by the Division of Chemical Sciences, Office of Basic Energy Sciences at DOE's Office of Science.

— Karen McNulty Walsh

NYS Senators Balboni, Flanagan Visit BNL to Learn About Lab's Homeland Security Initiatives, More

September 12, 2003

On Friday, September 12, New York State Senator Michael Balboni, 7th District, who chairs the Senate Committee on Veterans, Homeland Security and Military Affairs, and New York State Senator John Flanagan, 2nd District, who, among other contributions, is a member of that same Committee, visited BNL with Jim Sherry, Counsel to Balboni.

After being welcomed by BNL Director Praveen Chaudhari, as well as DOE's Brookhaven Area Office Manager Michael Holland, Associate Laboratory Director for Energy, Environment & National Security Ralph James, and Assistant Laboratory Director for Community, Education, Government & Public Affairs Marge Lynch, the party was taken to the Lab's Radiation Detector Testing & Evaluation Facility (RADTEC).

There, Charles Finfrock of the Energy Sciences & Technology Department; Biays Bowerman of the Environmental Sciences Department; and Paul Moskowitz of the Nonproliferation & National Security (NNS) Department outlined the purpose of RADTEC, which is twofold — to assemble, operate, and test commercial and government off-the-shelf technologies targeted for various homeland security applications, and to provide baseline data for comparison purposes. At the facility, researchers collect baseline data on various types of detectors, and are available to provide assistance in training city, state, and federal officials to operate the detectors and interpret the results. RADTEC is open to all commercial and government technology vendors and is expected to become an important resource for local, county, state, and federal officials.

The visitors next stopped at the NSLS, to meet Associate Laboratory Director for Light Sources and NSLS Chair Steven Dierker and NSLS scientist Peter Siddons, who gave an overview of some of the research done in such diverse fields as biology and physics, chemistry and geophysics, materials science, and medicine. The group then saw beamline X12A, where detectors being developed by BNL and others in support of homeland security initiatives are inspected at a new testing station.

The tour continued at the Instrumentation Division, where, a collaboration including NNS is developing a detector that acts as a camera to make images of objects that emit low-energy neutrons. As Vanier explained, since there are very few natural background neutrons, and they are uniformly distributed, a concentrated source of neutrons is strong evidence of a manmade device, such as a plutonium weapon, or of spent nuclear fuel.

Graham Smith, Instrumentation, then showed the visitors a working prototype of a xenon-filled gamma ray spectrometer that BNL is developing to detect radioisotopes potentially in the terrorist arsenal, such as dirty bomb materials. Xenon detectors can be built in very large sizes, so as to pick up signals of radioisotopes more quickly and over a wider area than do instruments now available. Hence, these detectors will be suitable for homeland security applications.

At BNL's Radiation Detector Testing & Evaluation Facility are: (front, from left) NYS Senator John Flanagan, BNL's Ralph James and Paul Moskowitz, and NYS Senator Michael Balboni.

One of BNL's most enormous detectors, STAR, provided the next stop on the tour. The visitors learned from Tim Hallman, Collider Accelerator Department, that STAR tracks and analyzes thousands of particles, such as protons, neutrons, and pions, that may be produced in collisions of two beams of subatomic particles speeding around the tunnel at the Relativistic Heavy Ion Collider (RHIC). In the RHIC experiment, scientists expect to discover more about conditions that existed in the first few microseconds of the universe.

The visit concluded at the Positron Emission Tomography (PET) facility, where David Schlyer, Chemistry Department, described some of the Lab's pioneering neuroimaging research on the brain chemistry of addiction, aging, and diseases such as Parkinson's and Alzheimer's, and the recent PET research on imaging awake animals. Some of this work has veterinary support from the State University of New York's Downstate Medical Center in Brooklyn.

—Liz Seubert